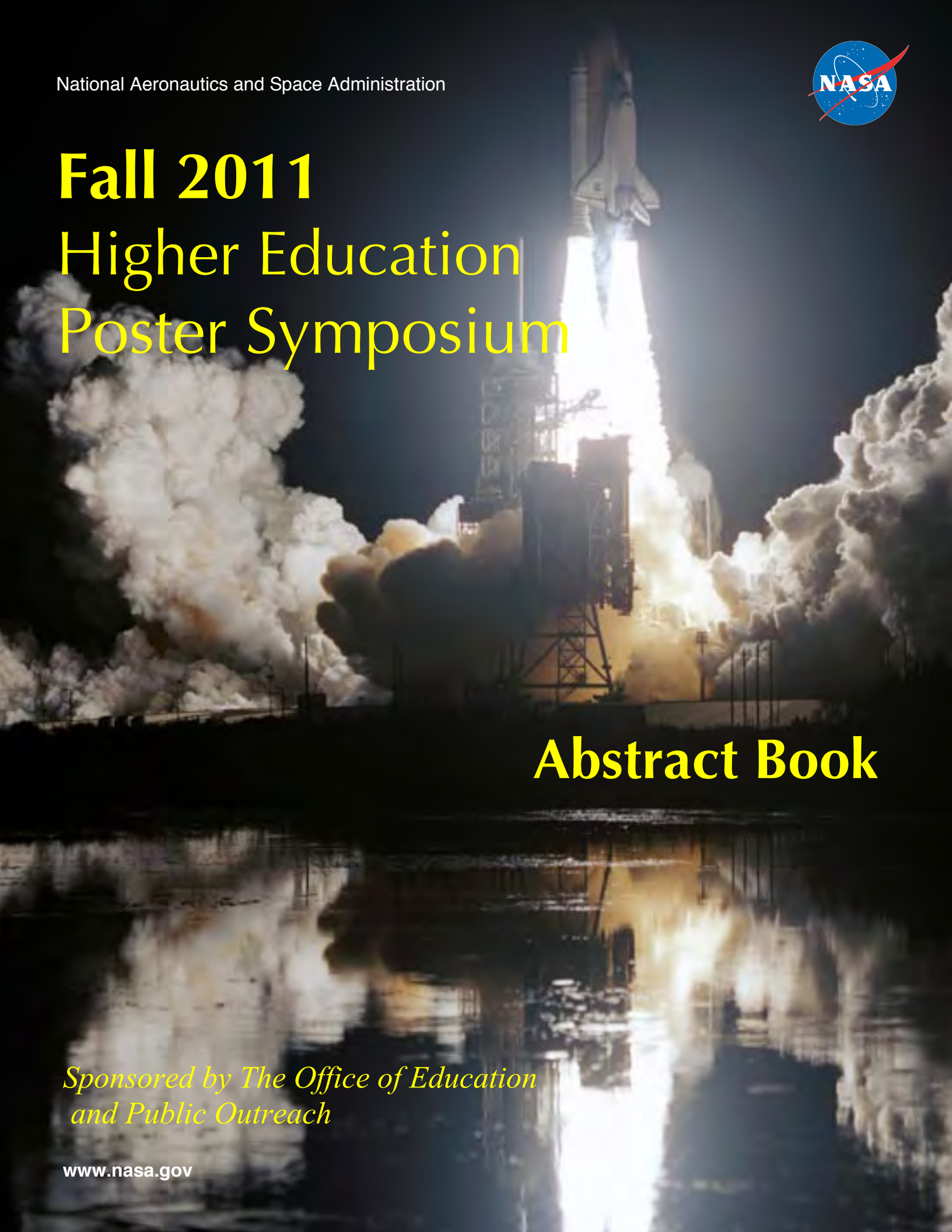
National Aeronautics and Space Administration



# Fall 2011
# Higher Education Poster Symposium

## Abstract Book

*Sponsored by The Office of Education and Public Outreach*

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*The Office of Education and Public Outreach is proud to share these abstracts from the undergraduate interns and graduate fellows at NASA Ames Research Center. During their time at Ames, these students have greatly contributed to the NASA mission through their research and mission support activities. The interns and fellows greatly enriched the Ames community and we look forward to welcoming these participants into our workforce in the future. A special thanks to the Ames community; we greatly appreciate the Ames staff in helping us develop the next STEM workforce.*

**Brenda Collins**
Higher Education Program Manager
NASA Ames Research Center

## Fall 2011 Cohort Programs

**CIPAIR** The Curriculum Improvements Partnership Award for the Integration of Research (CIPAIR) assists two and four-year minority institutions with strengthening their STEM academic fields and technical programs. The project will integrate project management methodology to strategically enhance STEM curricula.

*Ames CIPAIR Project Manager: Maria C. Lopez, AERO Institute*

**GSRP** The NASA Graduate Student Research Program (GSRP) is an Agency-wide fellowship program for graduate study leading to masters or doctoral degrees in the fields of science, mathematics, and engineering related to NASA research and development.

*Ames GSRP Project Manager: Maricela Varma, AERO Institute*

**SCEP** The Student Career Experience Program (SCEP) gives students an opportunity to combine their academic studies with on-the job training and experience. The SCEP provides paid work experiences for undergraduate, graduate and PhD students. Students may work part-time or full-time while attending school part-time or full time. The SCEP also provides non-competitive conversion to a term or permanent position once a student has met their education requirements.

*Ames SCEP/STEP Manager: Lyda Teov, NASA Ames Research Center*

**USRP** The NASA Undergraduate Student Research Project (USRP) offers year-round internship opportunities for undergraduate science, math, and engineering students. USRP is funded by the NASA Headquarters Office of Education.

*Ames USRP Project Manager: Maria C. Lopez, AERO Institute*
*Ames Academic Affairs Staff: Alex Nichol and Mary Schaadt, AERO Institute*

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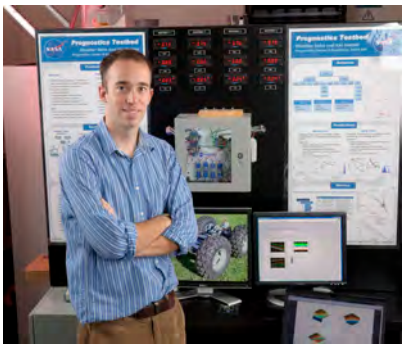


**Brian Bole,** *Georgia Institute of Technology*
Graduate Student Research Program (GSRP)

**Ph.D. Candidate**

**Mentor: Kai Goebel**
**Code: TI**
**Discovery and Systems Health (DaSH) Branch**

## A Stochastic Optimization Paradigm for Assessing and Managing the Risk Posed by Growing Fault Modes

It is an inescapable truth that no matter how well a system is designed it will degrade, and if degrading parts are not repaired or replaced the system will fail. Avoiding the expense and safety risks associated with failures is certainly a top priority in many systems; however, there is also a strong motivation not to be overly cautious in the design and maintenance of systems, due to the expense of maintenance and the undesirable sacrifices in performance and cost effectiveness incurred when systems are over designed for safety. In this research effort, an analytical approach is undertaken to incorporate future system and fault growth modeling uncertainties into probabilistic models for estimating the future effects of current control actions. A stochastic optimization paradigm is utilized to derive current control actions in terms of derived metrics that evaluate a relative aversion to probabilistic estimates of future control outcomes. Stochastic dynamic programming, a Markov model based stochastic optimization technique, is investigated for identifying control actions that best optimize derived risk metrics. Analysis of the stochastic optimization problem posed by battery charge depletion on a battery powered rover will illustrate some of the fundamental challenges associated with the general prognostics-based control design problem.

abstract book

**Sean Crawford,** *Western Washington University*

Undergraduate Student Research Program (USRP)

**Undergraduate Intern**

**Mentor: Terry Fong**
**Code: TI**
**Intelligent Robotics Group**

## Planetary Data, Intelligent Robotics Group (IRG) at NASA Ames Research Center: Serving 3D Mars Geodata on the Web

This project is the development of a Web site that delivers 3D Mars geographical data to the public via the Google Earth Browser Plugin. The Web site will showcase Mars satellite and ground photography, compiled as a 3D global map, similar to that in the Google Earth Desktop Client. The Web site will also contain interactive tours, information about notable features on the planet, information about the Mars Science Laboratory, an exploration history, current news related to Mars, and a Mars travel guide. The site is a NASA public outreach project, intended for use by scientists, students, and the curious space tourist. It is also a joint project between NASA and Google. The site is being developed by the Planetary Data Group within the Intelligent Robotics Group (IRG) at NASA Ames, and it is being funded by Google and will be hosted on Google infrastructure.


**Michael Henderson,** *Iowa State University*

Undergraduate Student Research Program (USRP)

**Undergraduate Intern**

**Mentor: Susan Frost**
**Code: TI**
**Intelligent Systems Division**

## Hardware Test Bed and Data Acquisition System for Wind Turbine Adaptive Control Algorithms

NASA is using its expertise in the areas of intelligent controls and systems health management to help broaden our nation's renewable energy portfolio. Wind turbine manufacturers and operators continually search for ways to maximize energy capture and production, as well as minimize turbine down-time and maintenance costs. Low frequency, time-varying structural modes can interfere with the control systems of utility scale wind turbines resulting in increased fatigue loads on the tower and blades. Disturbance accommodating adaptive residual mode filter control algorithms that allow wind turbines to operate optimally in the presence of these modes have been developed and tested in computer simulation by researchers at NASA Ames Research Center. The objective of this project is to create a hardware test platform composed of physical analogues to the wind turbine to enable validation of control algorithms in a physical setting. Forces, torques, and modes obtained from simulation data will be applied to a small-scale, dynamic model of a wind turbine tower and generator to facilitate observations of the system's modal response. Acceleration data acquired from this test bed, combined with fatigue analyses, will be used to aid in the development and implementation of advanced adaptive controls for wind turbines.

**Patricia Randazzo,** *College of Idaho*

Undergraduate Student Research Program (USRP)

**Undergraduate Intern**

**Mentor: Jose Celaya**
**Code: TI**
**Prognostics Center of Excellence**

## Accelerated Aging of Power Metal Oxide Semiconductor Field Effect Transistor (MOSFETs) Using Thermal and Electrical Stresses

Power electronics is a main component in many electrical systems used in the developing aerospace industry. Of the many important components commonly used in power electronics, this paper will focus mainly on testing parameters of Metal Oxide Semiconductor Field Effect Transistors (MOSFETs, a device used to amplify or switch electronic signals). The hypothesis we are testing is to confirm accelerated aging by thermal overstress results in degradation of the device's die-attachment. Furthermore, one can use in-situ measurements from electro-thermal transient response to assess state of health of the MOSFETs. The experiments discussed are expected to provide three results: 1) Aging experiments in varying loading conditions yield die-attachment degrades at different rates, 2) Monitoring of static parameters via a SMU test (source measurement unit) to observe degradation if possible, and 3) Update on experiments, enhancements, etc. to better assess the degradation process. To accelerate the life cycle of a MOSFETs, they will be subjected to thermal stresses and electrical stresses. Two types of power MOSFETs will be tested, IRF520NPbF (A standard HEXFET, n-channel, lead free power MOSFET) and IRL2910 (A logic-level HEXFET power MOSFET).

**Jendai Robinson,** *Virginia State University*

Undergraduate Student Research Program (USRP)

**Undergraduate Intern**

**Mentor: Dr. Jessica Koehne**
**Code: TSS**
**Nanotechnology Branch**

## Fabrication and Characterization of Nanoporous Alumina for Biosensing Applications

Currently, nanotechnology focuses on fabrication of resourceful materials at the nanoscale for applications in nanodevices. One such device is a nanopipette biosensor which creates a characteristic blockage through a “lock and key” method that can distinguish between various bio-molecules in order to diagnose infectious diseases, cancer and environmental conditions. This technology can be expanded to an array for signal redundancy and increased device yield. Specifically, nanoporous alumina, which is constructed from sheets of aluminum, can be anodized to produce highly ordered hexagonal nanoarrays. We are interested in obtaining a pore diameter of approximately 50 nm with even distribution throughout the array. The parameters controlled in order to achieve this are voltage, temperature, time and acid concentration. Characterization techniques employed were Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM). Current results show that ordered pores can be achieved after an electropolish pretreatment or two anodizations where the surface pores are removed by a chromic strip and anodized again on a new layer of alumina. Future work will focus on increasing pore depth, functionalizing with probe molecules and characterizing the current through the pore before and after the target molecule has been captured.

**Stacy Sakellarides,** *San Jose State University*

Student Career Experience Program (SCEP)

**Graduate Fellow**

**Mentor: Thomasa Nguyen**
**Code: HRM**
**Human Resources Management Division**

## Human Capital

The Office of Human Capital at Ames provides support to Center management and civil service employees in a variety of functions such as staffing, position classification, employee training and development, labor and employee relations (LR/ER) and workforce planning. I currently work as the Human Resources (HR) Manager for the Office of the Chief Financial Officer. In this role, I provide advice to the organization in all HR-related matters. As a member of the staffing team, I draft vacancy announcements, work with supervisors to identify critical skills for the position, and determine the applicants' qualifications after the vacancy closes. As a member of the LR/ER team, I work with supervisors on addressing performance and conduct issues and have gained a better understanding of various topics that are discussed between management and the union. I have also participated in analyzing the Employee Viewpoint Survey results, working on the buyout, and facilitating training. The different programs and projects I participate in provide me a broad knowledge base of HR functions.


**Olatunde Sanni,** *University of Maryland, College Park*

Undergraduate Student Research Program (USRP)

**Undergraduate Intern**

**Mentor: Jose Celaya**
**Code: TI**
**Prognostics Center of Excellence**

## Prognostics of Aluminum Electrolytic Capacitors in Critical Avionic Systems

A model-based assessment of the remaining useful life (RUL) of aluminum electrolytic capacitors in critical avionic devices is developed through experiments. Various capacitors are tested under various conditions ranging from nominal conditions to accelerated aging conditions such as electrical overstress and thermal overstress. The nominally operated capacitors are used in a switch mode power supply (SMPS), at room temperature. The electrical overstressed capacitors are also used at room temperature, but they are continuously charged and discharged at 80%, 100%, 120%, and 150% of the maximum rated voltage. The thermally overstressed capacitors are stored at 105 °C, but no electrical charge is applied to them. In both accelerated aging experiments, it is argued that the main cause of accelerated degradation is the increase in evaporation of electrolyte due to an increase in the capacitor's internal temperature. In order to monitor the degradation process, the equivalent series resistance (ESR) and capacitance are periodically characterized. The characterization process entails using Levenberg-Marquardt algorithm to fit the impedance frequency response of a capacitor model to the measured response. The estimated capacitance and ESR are used to build the RUL model and the results are reported at NASA Ames Prognostics Center of Excellence website.

**Karandeep Singh,** *Polytechnic Institute of NYU*
Undergraduate Student Research Program (USRP)

**Undergraduate Intern**

**Mentor: Michael M. Oye**
**Code: TSS**
**Entry Systems and Vehicle Development Branch**

## Piezoelectric Nanowires for Nanopower Devices

The focus of this research was to grow vertical Zinc Oxide (ZnO) nanowires that produce a voltage in response to applied mechanical stress (piezoelectricity) and to test the piezoelectric effect with the use of Atomic Force Microscopy (AFM). Piezoelectricity is commonly used in applications involving sound detection, microbalances, and ultrafine focusing of optical instruments. ZnO nanowires are considered to have good electrical properties, thus are used in solar cells, light emitting diodes (LEDs), chemical sensors, and in lasers and space application due to high radiation stability. This piezoelectric effect of ZnO nanowires could be used to create devices such as nanogenerators that will be able to produce charge through ambient movement such as footsteps. The piezoelectric ZnO nanowires were grown by Vapor Liquid Solid (VLS and self-catalyzed reactions) on a metal (Ag, Au, or Pt) coated Silicon wafer and on bulk metal substrates. Characterization was performed under a Scanning Electron Microscope (SEM), Electron Dispersive Spectroscopy (EDS), and an AFM with a metal (Pt) coated AFM tip. The bending of the ZnO nanowires creates a current, between the metal coated electrodes (AFM tip and the Si wafer), which is measured by a Pico ammeter connected to the AFM.

**Christopher Teubert,** *Iowa State University*

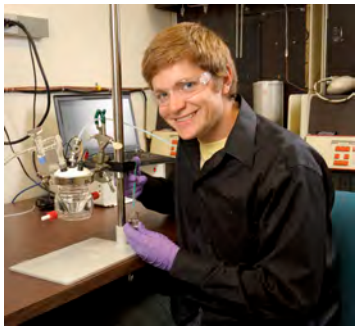
Undergraduate Student Research Program (USRP)

**Undergraduate Intern**

**Mentors: Scott Poll; Bryan Matthews**
**Code: TI**
**Intelligent Systems Division**

## Plug Load Management and Anomaly Detection System Development for the NASA Ames Sustainability Base

The National Aeronautics and Space Administration (NASA) Ames Research Center Sustainability Base showcases new cutting-edge improvements in green building. Building systems' energy demands are dramatically decreased through improved building materials, reduced waste, emerging technology and changes in building design. Additional energy waste reductions are achieved through the previously under investigated field of plug load management. This paper documents the process employed to monitor and reduce individual plug energy waste through enacting active load control systems, using improved machine policy settings, employing beneficial behavioral changes, and recommending energy efficient hardware. Additionally, we are investigating and developing anomaly detection applications employing the plug load management infrastructure. Applying passive anomaly detection systems detects abnormal plug loads to locate malfunctioning equipment and notify responsible personnel. This information is used to eliminate energy waste, productivity loss and damage from operating malfunctioning equipment. Recommendations made in this paper will be employed to reduce building energy consumption and aid in maintaining high productivity standards at the NASA Ames Research Center Sustainability Base.



**Ben Ungs,** *University of Iowa*

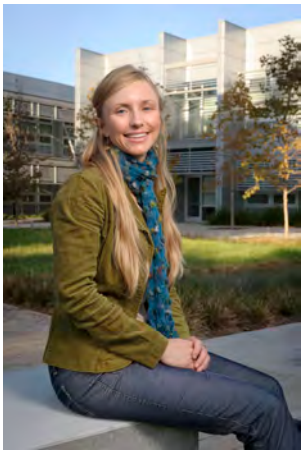
Undergraduate Student Research Program (USRP)

**Undergraduate Intern**

**Mentor: Dr. Bin Chen**
**Code: SST**
**Space Science and Astrobiology Branch**

## Photocatalysis Improvement via Nanowire Composites

Photocatalytic reactions utilizing titanium (IV) dioxide are being investigated for green energy applications, such as converting harmful species like carbon dioxide into methane. When carbon dioxide and water are passed over titanium dioxide, methane is formed, which is useful for fuel cell fuels. Titanium dioxide is an efficient absorber in the ultraviolet spectrum, but poor at absorbing visible light, so there is potential for its improvement as a photocatalyst. This research aims to improve the efficiency of the titanium dioxide nanowire photocatalyst by creating a composite, through use of other nanomaterials such as manganese- or tungsten-oxide nanowires. A composite will have a wide range band gap for energy absorption, and improve the performance of the titanium dioxide composite as a photocatalyst. Composites will be formed by dissolving titanium dioxide and either manganese- or tungsten- oxide in a solvent to cast them on glass slides, allowing analysis of their photocatalytic effects by passing carbon dioxide and water and measuring methane output. Synthesized composites will be characterized by spectroscopy (RAMAN, Infrared, Ultraviolet, X-ray Photoelectric), Scanning Electron Microscopy, and Surface Area Analysis.



**Angie Vanhoozer,** *University of Idaho, Moscow*

Graduate Student Research Program (GSRP)

**Ph.D. Candidate**

**Mentor: Nancy Smith**
**Code: TH**
**Human Systems Integration Division**

## Energy Conservation Awareness Study: Attitudes and Behavioral Effects for Occupants in a Net-zero Energy Office Facility

The purpose of my graduate research is to study energy conservation awareness, attitudes and behavioral effects for occupants in a net-zero energy office facility. Research employs longitudinal observation of awareness, attitudes and behaviors regarding energy system functions in workplace environments in order to track work-related changes attributable to increased conservation awareness and behaviors in residential systems. Research addresses the central question ***"How does immersion in a net-zero energy work environment affect energy use awareness and attitudes for employees in the contexts of workplace and residential environments?"*** The study presents a timely opportunity for landmark longitudinal analysis because the net-zero energy facility is recently constructed and not yet occupied. Through pilot and pre-occupation surveys, we anticipate gauging a baseline of awareness in traditional office environments. From this baseline, changes in awareness and attitudes attributable to the net-zero work environment, as well as transferred awareness to residential systems, can be tracked. Long term goals of the study involve development of a behavioral-study tool capable of assessing the degree to which net-zero energy building designs facilitate environmental affects beyond the buildings and into surrounding energy networks.

**Joni De Guzman,** *University of Illinois, Urbana-Champaign*
**Carson Turner,** *Iowa State University*

Undergraduate Student Research Program (USRP)

**Undergraduate Interns**

**Mentor: William Warmbrodt**
**Code: AUA**
**Aeromechanics Branch**

## UH-60A Data Report, LRTA Testing, and V-22 Model Completion

In 1993 the UH-60 Airloads Program collected an extremely large amount of flight data on the UH-60 Black Hawk helicopter. The goal of the UH-60 data report project is publication of the first technical memorandum of the data acquired from one of the over 900 tested flight conditions, with the hopes that the process utilized will serve as a model for future publications. The process includes creating a repeatable program to move all data from the TRENDS database into correctly formatted tables which are then grouped into appendices. Additional Black Hawk tests are being performed using the Large Rotor Test Apparatus (LRTA) to better understand the stiffness of the actuators inside the rotor hub. The task for this project is to assist with data collection. The branch has also purchased an R/C 1:18 scale model V-22 Osprey. This has been completely assembled, but still requires calibration of the controls and electronics before it is ready for flight.


**Jose Carrillo**[1], *Cañada College*
**Arturo Montoya**[1], *Cañada College*
**Joy Franco**[1], *Cañada College*
**Christian Rodriguez**[1], *Cañada College*

Curriculum Improvements Partnership Award for the Integration of Research (CIPAIR)

**[1]Undergraduate Intern**
**[2]Graduate Student Mentor**

**Mentors:**
**Ankita Goel**[2]
**Hamid Mahmoodi, Ph.D.**

## Summer Research Internship on Embedded Systems for Community College Students

Research internship opportunities for sophomore community college engineering students are not commonplace due to perceived lack of experience and technical knowledge among these students when compared to upper-division engineering students from research universities. In summer 2011, a group of community college students participated in a summer internship at San Francisco State University (SFSU). The 10-week internship program funded by NASA included a group of students who worked on developing curriculum on Embedded Systems for upper-division and graduate courses at SFSU. One of the group's objectives was to use an educational development board called Altera FPGA to understand embedded systems utilizing the Quartus II design software. Instructional materials on using the educational development board were developed for upper-division and graduate courses in computer engineering. Despite the participants' limited prior knowledge of embedded systems, and previous experience or course work in computer engineering, the participants were able to achieve the program's major goals. Among the materials produced were instructional videos and laboratory manuals on a variety of topics including an Introduction to the DE2-115 Development and Education Board, Hardware Design Flow Using Verilog in Quartus II, and Hardware and Software Codesign Flow. This poster presentation provides some of the details of the projects and accomplishments during the internship program, as well as the perspectives of the student participants including the perceived benefits, successes, and challenges of the program.


**Esther Chan**[1], Cañada College
**Enrique Raygoza**[1], Cañada College
**David Carillo**[1], Cañada College
**Andres Preciado**[1], Cañada College

Curriculum Improvements Partnership Award for the Integration of Research (CIPAIR)

[1]**Undergraduate Intern**

**Mentors:**
**Hao Jiang, Ph.D**
**Di Lan, M.S.**

## Developing a Temperature and Pressure Data logger for Biomedical Application

This project focuses on creating a data logger from a printed circuit board that records pressure and temperature changes due to magnets implanted inside patient with a hollow chest condition. The magnets gradually pull the sternum outwards to realign with the ribcage, the data logger is designed to monitor subtle changes within the patient in real time. Creating the data logger is a multi-step process that requires the use of software such as OrCAD Capture and PCB Editor. Using an existing circuit schematic design, the group's responsibility was to construct the data logger so it can be manufactured into either a two-layer, or a six- layer printed circuit board. This involved gathering all the necessary datasheets and information on manufacturing capabilities, creating footprints for the components used, generating a bill of materials and a netlist, drawing a board outline and placing parts within the board outline, routing the board, producing the artwork, and generating the necessary manufacturing files. With the completion of this project, the group learned that developing a data logger requires adherence to manufacturing standards and analysis of how signal integrity can be maintained throughout the entire design process, especially for the six-layer board. The group didn't take signal integrity into account during the research due to lack of experience in PCB design. Therefore, only the two- layer board was completed successfully and is ready to be manufactured.


**John Paulino**[1], *Cañada College*
**Jose Valdovinos**[1], *Cañada College*
**Andrew Chan**[1], *Cañada College*
**Moises Quiroz**[1], *Cañada College*

# Curriculum Improvements Partnership Award for the Integration of Research (CIPAIR)

**[1]Undergraduate Intern**
**[2]Graduate Student Mentor**

**Mentors:**
**Qi Ming Zeng**[2]
**Cheng Chen, PhD.**

## Seismic Design And Evaluation of a Special Moment-Resisting Frame

The NASA CIPAIR (Curriculum Improvements and Partnership Award for the Integration of Research) Program is a summer internship program that gives community college students the opportunity to learn about various engineering disciplines and apply the knowledge acquired in school to real world problems. The Earthquake Engineering team from Cañada College studied the performance and integrity of structures during major earthquakes. Students conducted research on seismic systems, structural design, and time history analysis. Much of the research focused on moment resisting frames. In designing these frames, students relied on building codes to ensure the safety of the structure, and used the Equivalent Lateral Force Procedure (ELFP) to determine the stresses of the structure and to find appropriate beam and column members of the building. The interns also conducted research on time history analysis. Four sets of earthquake data – Landers, Loma Prieta, Kobe, and Northridge Earthquakes – were integrated into the simulation. Using Structural Analysis Program, SAP2000, students were able to examine story drift. In addition to learning about Earthquake Engineering, the interns also facilitated an interactive presentation to high school students to encourage them to pursue careers in math, science and engineering. Lastly, the interns created tutorials to help improve community college and university curriculum. Internship programs such as the NASA CIPAIR help prepare community college students not only for their chosen university, but also for the professional world.